

REMARKS

Claims 1-19 are pending, with claims 1-4 withdrawn from consideration as directed to a non-elected invention.

In the final Office Action, the Examiner rejected claims 5-12 under 35 U.S.C. § 103(a) as unpatentable over Ohuchi (U.S. Patent No. 6,762,468) in view of Verret (U.S. Patent No. 6,130,144) and Bar-Gadda (U.S. Patent No. 6,579,805); and rejected claims 13-19 under 35 U.S.C. § 103(a) as unpatentable over the admitted prior art of Fig. 26 (APA) in view of Verret and Bar-Gadda.

Applicant traverses the claim rejections under 35 U.S.C. § 103(a), because a prima facie case of obviousness has not been established.

To establish a prima facie case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. M.P.E.P. § 2143, 8th ed., Revision of August 2005.

The rejection of claims 5-12 under 35 U.S.C. § 103(a) as unpatentable over Ohuchi in view of Verret and Bar-Gadda is improper for the following reasons.

Independent claim 5 recites a method of manufacturing a semiconductor device that includes, inter alia, "thermal-oxidizing the conductive film in an atmosphere that

contains an oxidant for oxidizing the first semiconductor and a reductant for reducing the second semiconductor, to form an oxide film made of the first semiconductor on the conductive film."

The Examiner acknowledged that "Ohuchi differs from the claims in not disclosing that the oxidation atmosphere contains an oxidant for selectively oxidizing Si and a reductant for reducing Ge." Office Action, pp. 2-3. In other words, Ohuchi fails to teach or suggest at least "thermal-oxidizing the conductive film in an atmosphere that contains an oxidant for oxidizing the first semiconductor and a reductant for reducing the second semiconductor, to form an oxide film made of the first semiconductor on the conductive film," as recited in claim 5.

The Examiner attempted to cure the deficiencies of Ohuchi with Verret and Bar-Gadda. First, the Examiner attempted to establish that Verret evidences that Ohuchi's selective oxidation should be a steam process. Second, the Examiner attempted to show that one skilled in the art would have been motivated to combine Verret with Ohuchi. Third, the Examiner cited Bar-Gadda as evidence of the elements of the claimed invention missing in a combination of Verret and Ohuchi. Applicant traverses the Examiner's positions as follows.

In an attempt to establish that Verret evidences that Ohuchi's selective oxidation should be a steam process, the Examiner first alleged that

Verret teaches that when a SiGe layer 32 is oxidized in steam, a SiO₂ layer 36 is formed by consuming the Si of the SiGe layer 32 without substantially disturbing the Ge in the SiGe . . . (Fig. 2c and col. 5, lines 6-16). . . . Thus, one of ordinary skill in the art would readily recognize that in order to achieve Ohuchi's selective oxidation, the oxidation condition **would have been steam**.

Office Action, page 3, emphasis added. The Examiner further alleged that

Verret reference was employed in the rejection to show that steam is an oxidation condition in which SiGe is selectively oxidized to form silicon dioxide while Ge in the SiGe layer is not oxidized, hence one of ordinary skill in the art would readily recognize that in order to achieve Ohuchi's selective oxidation of the SiGe gate electrode 8a, the oxidation condition would have been steam

Office Action, page 7, emphasis added.

Applicant disagrees with the Examiner. As Applicant previously pointed out, according to Verret, steam is NOT required in the oxidization process in Verret. Request for Reconsideration filed on December 28, 2005, pages 3-4. A relevant portion of Verret teaches that "the [selective] oxidation step is preferably a steam oxidation step (to promote rapid oxide growth) . . ." Verret, col. 5, lines 14-15, emphasis added. Such teaching of Verret apparently suggests that there is at least some other condition in which a selective oxidation step can be performed, although steam oxidation is preferred. Therefore, the Examiner incorrectly concluded that, based on Verret's teachings, "the oxidation condition [in Ohuchi] would have been steam" (Office Action, pages 3 and 7).

The Examiner then alleged that

It would have been obvious to modify Ohuchi's teaching by performing the selective oxidation in steam as suggested by Verret because it is well [settled] that the selection of a known material (i.e., steam) based on its suitability recognized in the art for its intended use supported a *prima facie* obviousness determination (MPEP 2144.07).

Office Action, page 3.

Applicant disagrees with the Examiner. First, the Examiner seems to have considered the intended use of "steam" to be selective oxidation. However, such intended use is not recognized in Verret. As noted above, Verret only teaches that

steam is preferably used to "promote rapid oxide growth." Verret, col. 5, ll. 14-16. At least on this basis, the Examiner's allegation is incorrect.

Moreover, the Examiner has not shown any "reason, suggestion, or motivation in the prior art that would lead one of ordinary skill in the art to combine the references . . ." Smiths Industries, Medical Sys., Inc. v. Vital Signs, Inc., 183 F.3d 1347, 1356, 51 USPQ2d 1415, 1420 (Fed. Cir. 1999). Verret and Ohuchi are targeted at forming different semiconductor structures. Particularly, the selective oxidation taught in Verret forms pure Ge 34 with a thickness of about **5 to 50 nanometers** (Verret, col. 5, ll. 6-21). In contrast, Ohuchi teaches that the selective oxidation results in an increase in germanium concentration from 20% to 40% with an extension of **2 nm** from a source edge of a SiGe gate electrode (Ohuchi, col. 4, ll. 44-60). While Verret prefers a steam oxidation for a rapid oxide growth for forming about 5 to 50 nanometers of pure Ge 34, Ohuchi does not contain any suggestion that a layer of SiGe with 40% of Ge and an extension of 2 nm should be achieved through a rapid oxide growth. The Examiner has not established that the oxidation condition taught in Verret would be considered by one skilled in the art as an appropriate or desirable condition for achieving the much lower concentration of Ge and much smaller depth of the affected region as taught in Ohuchi.

Therefore, the Examiner failed to establish that "[i]t would have been obvious to modify Ohuchi's teaching by performing the selective oxidation in steam as suggested by Verret" (Office Action, page 3).

In fact, even a combination of Verret with Ohuchi still fail to teach or suggest at least "thermal-oxidizing the conductive film in an atmosphere that contains an oxidant

for oxidizing the first semiconductor and a reductant for reducing the second semiconductor, to form an oxide film made of the first semiconductor on the conductive film," as recited in claim 5. Verret merely teaches that "the [selective] oxidation step is preferably a steam oxidation step" (col. 5, lines 14-15), and is silent to the details of the selective oxidation step.

In view of the above, Ohuchi and Verret, taken alone or in combination, fail to teach or suggest each and every element of claim 5. One skilled in the art would not have been motivated to combine Verret with Ohuchi.

The Examiner cited Bar-Gadda as "a factual evidence showing that the steam oxidation atmosphere taught in the combined process of Ohuchi and Verret contains both oxidant (H_2O) for oxidizing Si and reductant (H_2) for reducing Ge as claimed." Office Action, pages 3-4. However, because, as noted above, Ohuchi does not teach or suggest that the selective oxidation is a steam oxidation process, and one skilled in the art would not have been motivated to combine Verret with Ohuchi, the discussion of Bar-Gadda as evidence of the details of a steam process taught in a combination of Verret with Ohuchi is irrelevant. Moreover, Bar-Gadda only teaches a process for oxidizing silicon, not SiGe. The Examiner seemed to have considered that the conditions for oxidizing silicon should be the same as those for oxidizing SiGe. Office Action, pages 3-4. To the extent this is true, Applicant respectfully requests that the Examiner provide evidentiary support for his belief. Absent any evidentiary support, the Examiner failed to establish that Bar-Gadda teaches the above-quoted step of claim 5, which is missing in the combination of Ohuchi and Verret. Therefore, Bar-Gadda fails to cure the deficiencies of Ohuchi and Verret.

In view of the above, Ohuchi, Verret, and Bar-Gadda, taken alone or in combination, fail to teach or suggest at least “thermal-oxidizing the conductive film in an atmosphere that contains an oxidant for oxidizing the first semiconductor and a reductant for reducing the second semiconductor, to form an oxide film made of the first semiconductor on the conductive film,” as recited in claim 5. One skilled in the art would not have been motivated to combine the references in achieving the claimed invention. Therefore, claim 5 is allowable over Ohuchi, Verret, and Bar-Gadda. Claims 6-9 depend from claim 5 and are also allowable at least because of their dependence from an allowable base claim.

In addition, independent claim 10 recites a method of manufacturing a semiconductor device that includes, inter alia, “thermal-oxidizing the gate electrode in an atmosphere that contains an oxidant for oxidizing Si and a reductant for reducing Ge to form a sidewall insulating film on a sidewall surface of the gate electrode.” For reasons similar to those set forth above regarding claim 5, claim 10 is allowable over Ohuchi, Verret, and Bar-Gadda, as are claims 11-12, which depend from claim 10.

The rejection of claims 13-19 under 35 U.S.C. § 103(a) as unpatentable over APA in view of Verret and Bar-Gadda is also improper. Independent claim 13 recites a method of manufacturing a semiconductor device that includes, inter alia, “thermal-oxidizing the monocrystal layer in an atmosphere that contains an oxidant and a reductant as an oxidation seed to form an oxide film made of one of said at least two kinds of semiconductors on a surface of the monocrystal layer.”

The Examiner correctly recognized that “[t]he admitted prior art APA] differs from the claims in that while the admitted prior art forms the gate insulating film by

conventional oxidation process that results in a gate oxide film containing SiO₂ and GeO₂, the claims call for an oxidation process in an atmosphere that contains an oxidant for oxidizing Si and a reductant for reducing Ge so that the gate insulating film is made of substantially silicon oxide.” Office Action, p. 5. In other words, APA fails to teach or suggest at least the above-quoted element of claim 13.

For the reasons similar to those set forth above regarding claim 5, Verret and Bar-Gadda fail to cure the deficiencies of APA. Independent claim 13 is thus allowable, as are claims 14-16, which depend from claim 13.

Finally, independent claim 17 recites, inter alia, “wherein the gate insulating film is formed on a surface of the SiGe monocrystal layer by thermal-oxidizing the SiGe monocrystal layer in an atmosphere that contains an oxidant for oxidizing Si, and a reductant for reducing Ge, and the gate insulating film is made of substantially silicon oxide.” For the reasons similar to those set forth above regarding claims 13, independent claim 17 and its dependent claims 18-19 are allowable over APA, Verret, and Bar-Gadda.

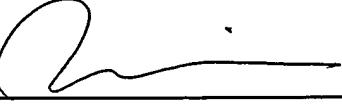
In view of the foregoing, Applicant requests reconsideration of the application and timely allowance of the pending claims.

Please grant any extensions of time required to enter this response and charge
any additional required fees to our deposit account 06-0916.

Respectfully submitted,

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By: 

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